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Mergers in the Nonfuel Minerals Industry: Trends and Motives

By James S. Grichar and Elizabeth H. Yaremchuk

UNITED STATES DEPARTMENT OF THE INTERIOR

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UNITED STATES DEPARTMENT OF THE INTERIOR
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MERGERS IN THE NONFUEL MINERALS INDUSTRY: TRENDS AND MOTIVES

By James S. Grichar[1] and Elizabeth H. Yaremchuk[1]

ABSTRACT

Interest in mergers in the nonfuel mineral industry developed when 5 were listed among the 50 highest valued mergers in the United States in 1981. This report presents a Bureau of Mines study of trends in merger activity from 1960 to 1979 and explores motives for mergers in the nonfuel mining and mineral industry. The objective was to determine precedent for or a trend toward the 1981 acceleration in merger activity and to examine certain financial motives for nonfuel mineral mergers. Data indicate that the relative value of nonfuel mineral mergers has grown since 1972 although the number of mergers has remained proportionate to historical trends for all mergers. Since 1974, the assets acquired in "large," nonfuel mineral firm mergers, those of $10 million or more, have comprised at least 93 pct of assets acquired. More nonfuel mineral firm mergers involved mineral companies as the acquiring firm than vice versa but mining and minerals firms acquired were of higher value than nonmining firms. A major motivation for mergers involving large mineral firms was the acquisition of assets at less than replacement costs. Univariate statistical testing, a methodology chosen for its applicability to the data, confirms this hypothesis while rejecting other financial motives. The remainder of the work is devoted to a discussion of suggested areas for future study.

INTRODUCTION

In 1981, five mergers involving nonfuel mineral firms took place, which together were valued at almost $7.5 billion (*1*).[2] This development led to speculation that remaining independent mining and mineral firms—strapped by high interest debt, foreign competition, and historically low commodity prices, but in possession of potentially valuable in-ground resources—would soon succumb to merger bids. Some mineral experts believe this action would be the only way to preserve the domestic industry in that the acquiring companies will become a source of funds to mineral firms in need of investment capital. Others suggest the total submersion of the mining and mineral industry into companies in other fields will hasten the demise of the domestic industry, since mining and mineral investments often do not provide the return on investment of other product lines, and will not receive adequate funding. The debate between the two schools of thought may soon be academic, however, since for example, 7 of the 11 largest U.S. copper producers have been acquired in the last 20 years. On the other hand, companies such as U.S. Steel may have forestalled takeover attempts by becoming acquirers themselves.

Mining and mineral companies have been at the forefront of the three "waves" in merger activity that occurred in the U.S. prior to 1979. Figure 1 shows the number of mergers each year for the 1895-1978 period. During the first peak in activity, which occurred at the turn of the century, U.S. Steel was established after a series of horizontal integrations. The second wave of merger and acquisition activity began just prior to the 1920's, and peaked in 1928. During this period, mergers in the food processing, chemical, and mining sectors comprised 60 pct of all merger activity; and extensive vertical integration in mining led to the founding of Kennecott, Anaconda, Phelps Dodge, Bethlehem Steel, and Republic Steel (*2-3*).

The third merger wave began in the 1950's, although activity did not peak until the late 1960's and early 1970's. Unlike the earlier waves in which the principal result of merger activity was the consolidation of firms that produced related products, this period of accelerated merger activity was distinguished by corporate diversification into new product markets. Mining and mineral firms were often a target in these conglomerate mergers, but often, the opposite was true. The "Characteristics of Mergers in the Nonfuel Mining and Minerals Industry, 1960-79" section of this report examines the extent of merger activity from 1960 through 1979 based on data obtained from the U.S. Federal Trade Commission (FTC). It covers the topic from several perspectives including volume, value, and the extent of nonfuel mining and mineral processing firm mergers in relation to all other mergers. It also seeks to determine what types of mining

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[2] Italic numbers in parentheses refer to items in the list of references at the end of this report.

and mineral processing firms were connected with merger activity and other trends.

The 1981 increase in merger activity induced speculation about the reasons for mergers and raised questions concerning the future viability of the domestic mineral industry. The "Motives for Mergers" section explores several financial motives for recent merger activity among eight large mineral firms, using data extracted from annual reports, and discusses possible areas of future research.

This report does not examine the topic of foreign equity ownership of domestic mineral firms. The degree to which domestic mining and mineral firms have been acquired by foreign interests is unknown and difficult to trace. Two notable recent mergers are the Elf Aquitane (France) acquisition of Texasgulf in 1980 and the partial acquisition of Kennecott by British Petroleum through its majority ownership of Standard Oil (Ohio) in 1981. Data on foreign acquisitions are aggregated into data used in this study, but are not dealt with as separate issues.

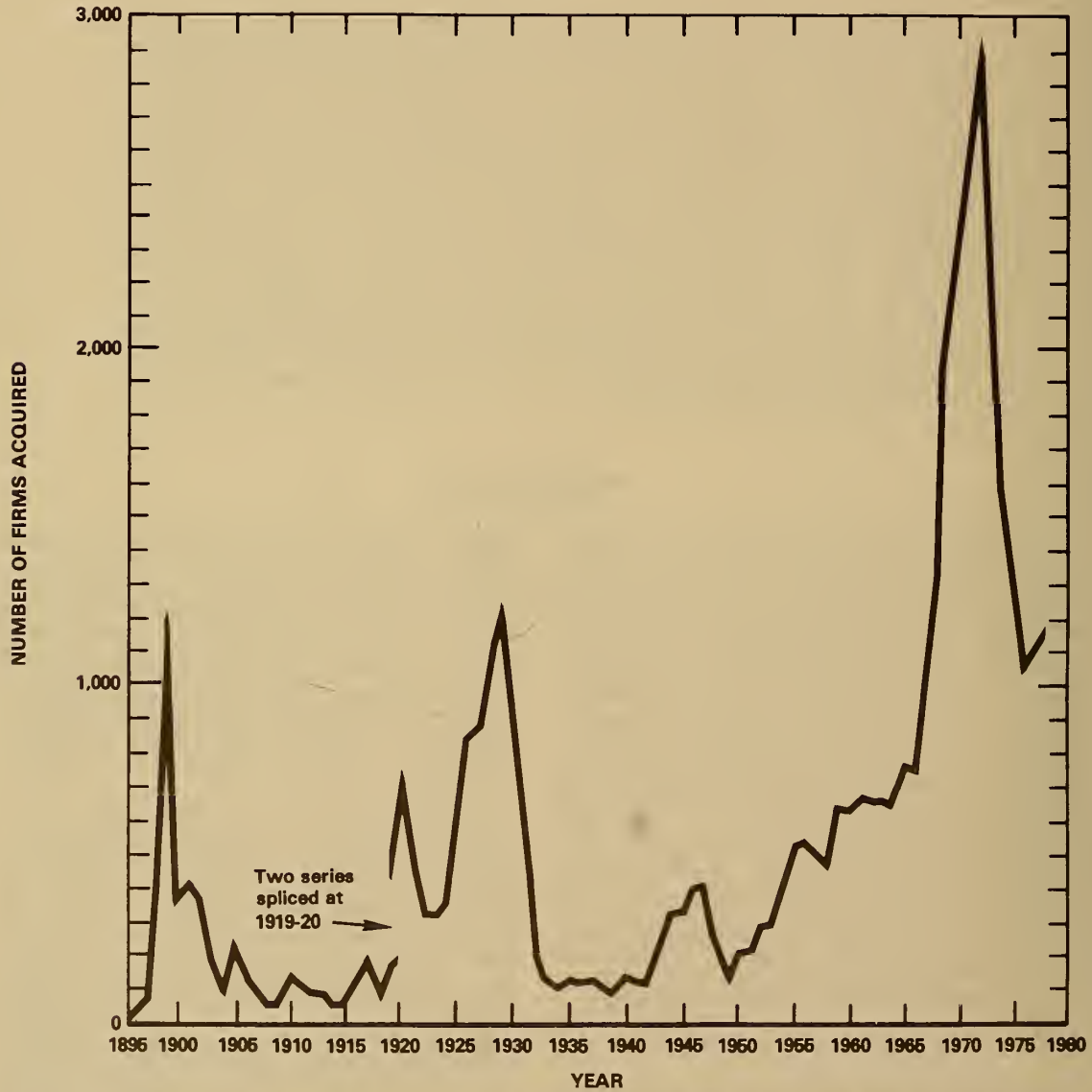

Figure 1.—Number of manufacturing and mining firms acquired, 1895-1978. (Source: Malcolm S. Salter and Wolf A. Weinhold, DIVERSIFICATION THROUGH ACQUISITION: STRATEGIES FOR CREATING ECONOMIC VALUE. New York: The Free Press, a Division of Macmillan, Inc., 1979, p. 10.)

CHARACTERISTICS OF MERGERS IN THE NONFUEL MINING AND MINERALS INDUSTRY, 1960-79

Merger activity from 1960 to 1979 was marked by two separate developments. In the first, a rise in the volume of merger activity occurred. In the second, an increase in the value of mergers developed. Nonfuel mining and mineral industry mergers were a constant component of both developments. From 1966 to 1969 a wave of activity occurred where the number of mergers rose to two and three times prior activity. Nonfuel mining and mineral industry mergers closely tracked the trend in the volume of all mergers, comprising roughly 5 pct. They again followed the trend of overall mergers when from 1975 to 1978 the total value of mergers accelerated to many times previous values. The primary purpose of this section is to describe trends in the volume and value in nonfuel mining and mineral mergers from 1960 to 1979, and the kind of firms and to what degree nonfuel mineral firms merged.

DATA SOURCE AND LIMITATIONS

From 1960 through 1979, the FTC collected information (*4*) on mergers and acquisitions in the mining and manufacturing industry for use in its publication, *Statistical Report on Mergers and Acquisitions,* which has been discontinued. The FTC staff relied on published reports in business and financial newspapers and journals for indications of merger activity. Merger reports were chronicled with the names of the two companies involved, their respective Standard Industrial Classification (SIC)[3] codes, the asset value for each (when available), the date of merger, and other salient statistics. Although the FTC discontinued collecting this data in 1979, this data series was chosen because it was readily available, covered the longest time span, provided the most information, was computerized, and had merger data available by SIC code.

The SIC code was used to limit the merger group sample to mining and mineral firms. The FTC used a four-digit SIC code to describe the major function of each company. The first two digits of a SIC code describe the "major group." All mergers were included that involved companies classified under major groups: metal mining (10), nonmetallic mining except fuels (14), primary metals (33), and all of the various subgroups of these major groups, plus asbestos products (3292). On this basis, the computer search arrived at 1,684 observations.[4,5]

There are several limitations inherent in the data. There is the question of the completeness: (1) the FTC may not have catalogued all reported and published mergers, (2) the news media may not have covered all mergers because of the space made available to print information and its newsworthiness, and (3) most transfers of privately owned companies probably would not be publicized. It has been assumed for this report, however, that all large, significant mergers are included in the data.

Another limitation involves the use of obsolete or inaccurate SIC codes. Since 1960, the SIC codes have been revised on several occasions, usually to consolidate subgroupings, occasionally to add a new subgroup. In aggregate SIC statistics, however, code revisions rarely redefine an industry's (and therefore a firm's) classification from one major group to another. Because the sample group was based on the major groups, not the subgroups, this should not pose a significant limitation to the data.

A more significant problem with SIC codes concerns the larger or conglomerate companies that are active in many aspects of commerce and trade. It is meaningless to use a single SIC code for a conglomerate firm, but it is done. It is possible, therefore, that a large mining and mineral interest may have been excluded from the sample because the single SIC code applied to the company may have been outside the realm of mining and mineral activity. For example, conglomerate firms with mining and mineral activity in the company portfolio may be recorded under the major group wholesale trade—durable goods (50) or the major group holding companies (67). It was not possible to determine to what extent this may have affected the sample.

Finally, asset data were sparse, especially in the early years of data, and asset data are always questionable. The size of a merger was determined on the basis of assets listed for the acquired company. While only 349 of the 1,684 mergers reviewed contained an asset value for the acquired company, for the most part the asset values available were for the largest mergers. Therefore, although only 20 pct of mergers report asset value, the total of all values reported approaches 100 pct of all assets acquired. The limitations of the FTC data are not uncommon for this sort of data, however they are assumed, at the very least, to be representative of the major trends in merger activity.

NONFUEL MINING AND MINERAL INDUSTRY MERGERS, 1960-79

Figure 2 displays an index of the number of (1) all mergers in the U.S. between 1960 and 1977, (2) manufacturing and mining mergers from 1960 through 1977, and (3) nonfuel mining and mineral processing (M&MP) mergers from 1960 through 1979. Indexing facilitates a comparison of the trends of the three groups. M&MP mergers have generally followed the overall trend in merger activity since 1960. All merger activity declined slightly until 1966 and then sharply accelerated until 1970, after which the number of mergers per year fell off sharply. Throughout the period, M&MP mergers accounted for a fairly constant proportion of mergers in the economy. In comparison with all mergers in the U.S. during this period, the share that involved M&MP firms averaged only 4 pct (table 1). M&MP mergers averaged approximately 8 pct of mergers in all the manufacturing and mining category.

[3] The SIC defines an industry in terms of product or function. The code was developed by the Office of Management and Budget (OMB) to promote the comparability of statistics.

[4] In *The Standard Industrial Classification Manual,* a two-digit code denotes a major group. A three-digit code is an industry group. A four-digit code is a specific industry.

[5] A comprehensive listing of mining and mineral firm mergers (1960-79) is available upon request from the authors.

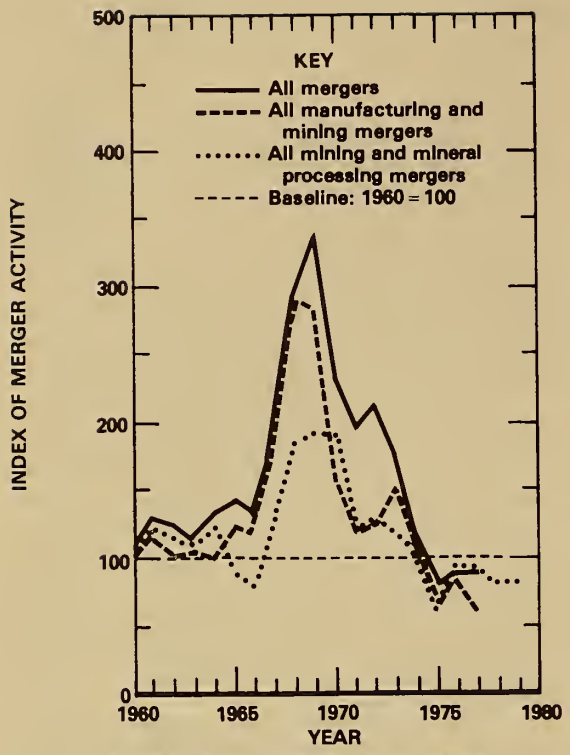

Figure 2.—Index of merger activity, 1960-79.

Table 1.—Total U.S. company mergers, manufacturing and mining firm mergers, and mining and mineral firm mergers, 1960-79

Year	Total	Manufacturing and mining		Mining and mineral	
		Total	pct[1]	Total	pct[1]
1960	1,345	844	62.8	74	5.5
1961	1,724	954	55.3	88	5.1
1962	1,667	853	51.2	86	5.2
1963	1,479	861	58.2	79	5.3
1964	1,797	854	47.5	89	5.0
1965	1,893	1,008	53.2	63	3.3
1966	1,746	995	57.0	57	3.3
1967	2,384	1,496	52.8	91	3.8
1968	3,932	2,407	61.2	137	3.5
1969	4,542	2,307	50.8	144	3.2
1970	3,089	1,351	43.7	139	4.5
1971	2,633	1,011	38.4	86	3.3
1972	2,839	1,036	36.5	92	3.2
1973	2,359	1,275	54.0	87	3.7
1974	1,474	909	61.7	79	5.4
1975	1,047	578	55.2	43	4.1
1976	1,171	692	59.1	67	5.7
1977	1,182	483	40.9	66	5.6
1978	NA	NA	NA	58	NA
1979	NA	NA	NA	59	NA
Total	38,303	19,914	NAp	1,684	NAp

NA Not available. NAp Not applicable.
[1] Of all U.S. company mergers.

Source: Computed from data from U.S. Federal Trade Commission, Bureau of Economics, *Report on Mergers and Acquisitions*, Dec. 1978, and unpublished data.

Sample Groupings

M&MP firms can be involved in a merger in various ways. First, an M&MP firm may be acquired, either by a non-M&MP firm or by another M&MP firm (cases 1 and 3 of table 2). On the other hand, an M&MP firm may be the one acquiring either a non-M&MP firm or another M&MP firm (cases 2 and 3 of table 2). From 1960 through 1979, FTC data indicate non-M&MP firms acquired 504 M&MP firms, M&MP firms acted to acquire 920 non-M&MP firms, and there were 260 mergers among M&MP firms.

M&MP firms were the acquiring firm (case 2) in 55 pct of M&MP mergers and were the acquired firm (case 1) in about 30 pct of the total. In 15 pct of the mergers, both the acquiring and the acquired firm were M&MP companies. Figure 3 illustrates the changing percentage share of total mergers by case for the 1960-79 period. The percentage share of mergers in which M&MP firms were acquired by nonmining firms remained relatively stable throughout the period, while the percentage share of mergers by M&MP firms increased. The share of mergers in which both participants were M&MP firms dropped over the period.

Table 2.—Mining and mineral firm mergers, 1960-79

Case	Firm		Mergers
	Acquiring	Acquired	
1.	Nonmining and mineral	Mining and mineral	504
2.	Mining and mineral	Nonmining and mineral	920
3.	do	Mining and mineral	260

Periods of Merger Activity, 1960-79

Figure 4 charts the number of mergers per year by case. Four major periods of merger activity involving M&MP firms between 1960 and 1979 are indicated: 1960-67, 1968-70, 1971-74, and 1975-79. From 1960 through 1967, M&MP firms were acquired in 203 mergers by non-M&MP firms, acquired non-M&MP firms in 291 mergers, and comprised both parties in 133 instances. The total number of mergers for the period was 627 and the average number per year was 78 (see table 3).

The period of merger activity from 1968 through 1970 showed a marked increase in the number of recorded mergers per year. For this 3-year period, the average number of mergers increased to 140 per year. The primary

Table 3.—Mining and mineral firm mergers during four periods of merger activity, 1960-79

Period	Firm role			Total
	Acquired, case 1	Acquiring, case 2	Acquired-acquiring, case 3	
	TOTAL MERGERS			
1960-67	203	291	133	627
1968-70	121	236	63	420
1971-74	97	211	36	344
1975-79	83	182	28	293
Total	504	920	260	1,684
	AVERAGE MERGERS PER YEAR			
1960-67	25	36	17	78
1968-70	40	79	21	140
1971-74	24	53	9	86
1975-79	17	36	6	59

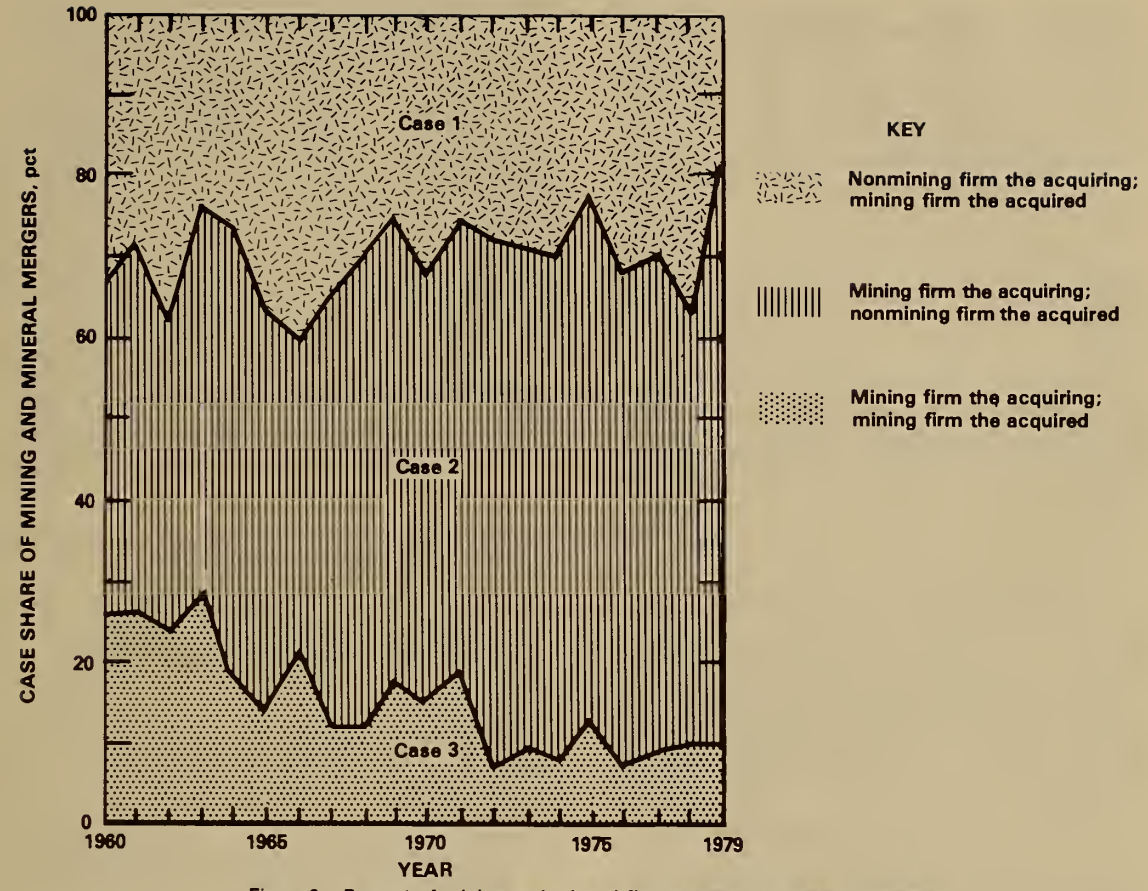

Figure 3.—Percent of mining and mineral firm mergers, by case, cumulative.

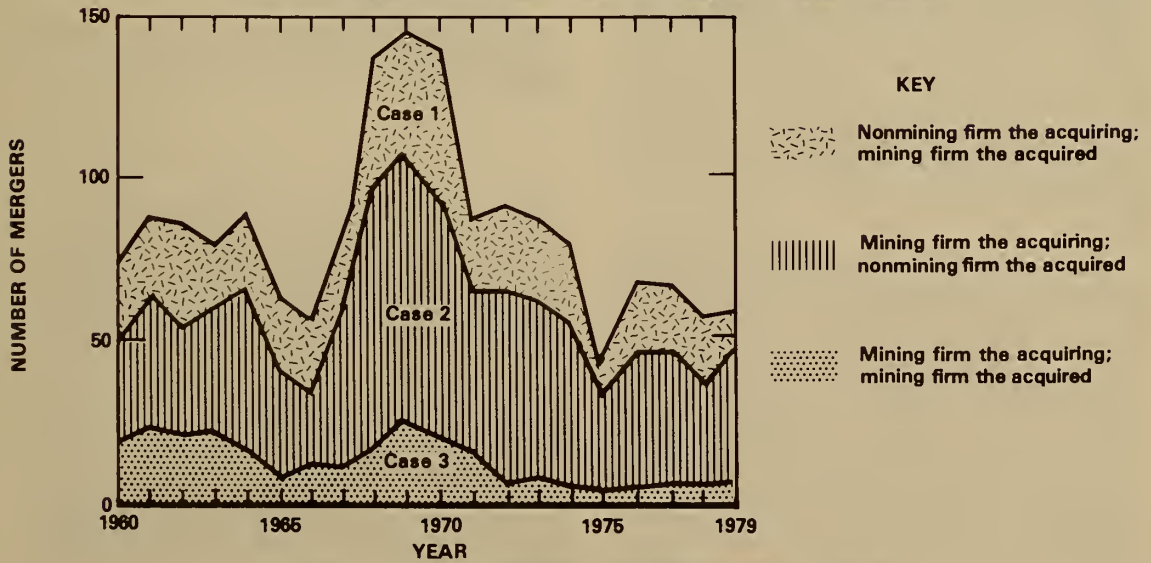

Figure 4.—Number of mining and mineral firm mergers, by case.

cause was an increase in acquisitions of nonmining properties by M&MP firms although there was also an increase in the yearly average of M&MP firms acquired. From 1968 through 1970, M&MP firms acquired 236 nonmining firms. During the same period, 121 M&MP firms were acquired by non-M&MP firms, and there were 63 mergers between M&MP firms. This peak period of merger activity in the M&MP industry was part of an overall wave of merger activity in the U.S. business community; however, the wave in M&MP merger activity continued 1 year longer (see figure 2).

Between 1971 and 1974, the number of acquisitions reverted to prewave levels. Nonmining firms acquired M&MP firms in 97 instances, M&MP firms acquired nonmining firms in 211 instances, and there were 36 mergers between M&MP firms. The level of activity of M&MP firms acquiring non-M&MP properties, however, remained higher, with an average of 53 per year, than the prewave level of 36 per year. Mergers between M&MP firms dropped below prewave levels from 17 during the average year to 9 per year. The number of acquisitions of M&MP firms by non-M&MP firms reverted almost exactly to prewave levels.

The last period, 1975-79, showed a further decline in merger activity. Only 293 mergers involving M&MP firms took place during the period, with an average of 59 per year. Mining firms acquiring nonmining properties still accounted for the largest proportion of activity with 182 mergers, followed by 83 mergers in which M&MP firms were acquired by nonmining firms. There were a total of 28 mergers between M&MP firms during the period. The yearly average number of mergers between M&MP firms dropped to 6 per year while other averages dropped to 36 per year for M&MP firms acquiring non-M&MP companies and 17 where M&MP firms were acquired by non-M&MP companies.

Types of Firms Merged

Although mergers in the nonfuel minerals industry generally followed the cyclical trend of all mergers from 1960 to 1979, the trend in the type of merger in which M&MP firms participated was not the same. Overall merger activity experienced a shift away from horizontal and vertical mergers toward conglomerate mergers, while most of M&MP mergers were the result of diversification and vertical integration. When M&MP firms merged with other M&MP firms, it was most often between firms in the same industry group.

Case 1

M&MP firms were acquired by nonmining firms classified under the following nine SIC divisions: agriculture, fuel minerals, construction, manufacturing, transportation, wholesale trade, retail trade, finance, and services. Table 4 contains a matrix of mergers classified under case 1. M&MP firms were acquired by manufacturing firms in 331 or 66 pct of the mergers. Fuel mineral firms and service companies represented 38 and 36 mergers respectively, or 15 pct of the total.

Of the three types of M&MP firms, primary metal firms were acquired at a significantly higher rate than metal mining or nonmetallic mineral firms. Acquisitions of primary metals represented 71 pct or 360 of case 1 mergers. Furthermore, the bulk of merger activity occurred between manufacturing firms and primary metal firms. This included 259 mergers or 51 pct of the total.

Of those 259 mergers, the majority of the acquiring firms were classified under eight major manufacturing industry groups and accounted for 235 mergers. Table 5 shows the detailed matrix of this predominant activity. Primary metal firms were acquired principally by firms that are downstream consumers of mineral products, especially metals. To a lesser extent primary metal firms were also acquired by firms within major groups that are downstream consumers of minerals, especially nonmetallics. Technology transfer and economies of scale may have contributed to the decision by these types of firms to acquire primary metal firms. Additionally, a degree of legal vertical integration may have contributed to any decision process.

Table 4.—Matrix of mergers by industry area of acquired and acquiring companies, case 1, 1960-79

SIC division of acquiring company	Major SIC industry group of acquired company			Total
	10, metal mining	14, 3292, nonmetallic minerals	33, primary metals	
A—Agriculture, forestry, and fishing	1	0	0	1
B—Mining (fuel minerals)	20	4	14	38
C—Construction	0	10	3	13
D—Manufacturing, except primary metals industries	16	56	259	331
E—Transportation, communications	4	1	6	11
F—Wholesale trade	1	2	17	20
G—Retail trade	0	1	3	4
H—Finance, insurance, and real estate	2	4	4	10
I—Services	3	10	28	41
Unknown	4	5	26	35
Total	51	93	360	504

Table 5.—Detailed breakdown of major groups that acquired primary metals firms, 1960-79

Major manufacturing industry group of acquiring company	SIC industry group of acquired primary metals company[1]							Total
	331	332	333	334	335	336	339	
28—Chemicals	5	3	4	2	6	2	2	24
30—Rubber and plastics	2	1	1	0	3	1	0	8
32—Stone, clay, glass, and concrete	1	1	1	0	1	1	2	7
34—Fabricated metal products	13	10	0	3	12	4	6	48
35—Nonelectrical machinery	11	15	1	1	10	4	8	50
36—Electrical machinery	6	6	0	0	18	11	16	57
37—Transportation equipment	2	9	1	1	4	5	3	25
38—Instruments	0	1	3	0	3	5	4	16
Total	40	46	11	7	57	33	41	235

[1] See table 7 for definition of industry groups.

NOTE:—The matrix details only those mergers where companies classified under the same industry group frequently targeted primary metals firms for acquisition. For this reason 24 acquisitions of primary metal companies do not appear in this table.

Case 2

M&MP firms acquired nonmining firms from a wide variety of fields. As with mergers in case 1, companies operating in fields in which there was some degree of technological transfer or vertical integration were the most likely candidates for acquisition. Table 6 provides a matrix of merger activity for case 2. M&MP firms acquired companies in agriculture, fuel mining, construction, manufacturing, wholesale trade, retail trade, finance, and services. As with case 1, the bulk of activity occurred between primary metal firms and manufacturing firms, who are downstream consumers of minerals, metals, and nonmetallics.

Table 7 provides a detailed breakdown of the chief manufacturing industries into which primary metals firms bought. A total of 433 mergers, 47 pct of mergers in case 2, took place between primary metals firms and nine manufacturing groups. Firms engaged in producing fabricated metal products and machinery, either electrical or nonelectrical, were primary targets.

Table 6.—Matrix of mergers by industry area of acquired and acquiring companies, case 2, 1960-79

Major SIC industry group of acquiring company	SIC division of acquired company[1]									Total
	A	B	C	D	F	G	H	I	Unknown	
10—Metal mining	0	19	4	52	12	1	6	6	30	130
14, 3292—Nonmetallic minerals	1	3	4	40	5	4	1	2	15	75
33—Primary metals	0	15	9	481	75	10	19	19	87	715
Total	1	37	17	573	92	15	26	27	132	920

[1] See table 4 for definition of divisions.

Table 7.—Detailed breakdown of manufacturing industries into which primary metals firms bought,1960-79

SIC industry group of acquiring company	Major manufacturing industry group of acquired company[1]									Total
	28	30	32	34	35	36	37	38	39	
331—Blast foundries	19	8	10	61	29	12	5	4	5	153
332—Iron and steel foundries	4	9	6	19	19	8	7	5	0	77
333—Nonferrous metals	4	1	3	13	6	10	6	1	0	44
334—Secondary nonferrous metals	1	0	0	4	1	1	2	0	0	9
335—Rolling and drawing of nonferrous metals	6	9	6	12	18	24	5	2	2	84
336—Nonferrous foundries	0	1	3	4	2	3	4	0	1	18
339—Miscellaneous industries	1	2	3	8	21	6	4	2	1	48
Total	35	30	31	121	96	64	33	14	9	433

[1] See table 5 for definition of industry groups. Industry group 39 is miscellaneous manufacturing industries.

Case 3

As a means to prevent the creation of large oligopolistic firms, antitrust legislation has curtailed mergers between firms that produce similar products. However, 84 pct of M&MP firms that merged were in the same industry group. Table 8 provides a matrix of mergers between M&MP firms. Two-thirds of the 260 mergers were between primary metal firms. Mergers between metal mining firms accounted for 14 pct, while mergers among nonmetallic firms comprised 4 pct of case 3 mergers.

Table 8.—Matrix of mergers and acquisitions by industry area of acquired and acquiring companies, case 3, 1960-79

Major SIC industry group of acquiring company	Major SIC industry group of acquired company				Total
	10, metal mining	14, nonmetallic minerals	3292, asbestos products	33, primary metals	
10—Metal mining	36	4	0	17	57
14—Nonmetallic minerals	1	11	0	2	14
3292—Asbestos products	0	0	1	2	3
33—Primary metals	11	3	1	171	186
Total	48	18	2	192	260

ROLE OF ENERGY COMPANIES

Fuel mineral mining firms and petroleum processing firms (energy companies) have been prominently involved in M&MP merger activity since 1979. Analysts perceived that the purchase of M&MP firms was a new and pervasive move on the part of oil companies but the empirical evidence does not support this. Energy firms acquired M&MP firms throughout the 1960-79 period. Table 9 shows the pattern of acquisition of M&MP firms by energy companies over the 1960-79 period. It includes SIC major group 13, oil and gas extraction, and SIC major groups 11, 12, and 29, which are, respectively, anthracite mining, bituminous coal and lignite mining, and petroleum refining. Together these major groups represent "energy companies," and represent 9.1 pct of case 1

Table 9.—Purchase of mining and mineral firms by energy companies, 1960-79

SIC code	1960-67	1968-70	1971-74	1975-79	Total
1111—Anthracite mining	2	0	0	0	2
1211—Bituminous coal and lignite	2	0	1	1	4
131X—Crude petroleum and natural gas	10	6	3	8	27
1381—Drilling oil and gas wells	0	1	0	0	1
1382—Oil and gas-field exploration services	2	0	0	0	2
1389—Oil and gas-field services	1	0	0	0	1
139X—Miscellaneous oil and gas	0	0	1	0	1
2911—Petroleum refining	2	2	1	2	7
295X—Paving and roofing materials	1	0	0	0	1
Total	20	9	6	11	46

Table 10.—Number of energy companies acquired by mining and mineral firms, by period and SIC code, 1960-79

SIC code	1960-67	1968-70	1971-74	1975-79	Total
1111—Anthracite mining	1	0	0	0	1
121X—Bituminous coal and lignite mining	0	0	3	0	3
1211—Bituminous coal and lignite	2	4	4	5	15
131X—Crude petroleum and natural gas	6	4	3	2	15
1381—Drilling oil and gas wells	0	1	0	0	1
1382—Oil and gas-field exploration services	0	0	1	1	2
2911—Petroleum refining	0	0	1	0	1
2952—Asphalt felts and coatings	0	0	1	0	1
Total	9	9	13	8	39

mergers. A review of table 9 shows that from 1960 to 1979 a total of 46 mergers of this type transpired. The pace of acquisition was approximately constant over the period, with more mergers occurring from 1960 to 1970 than afterward.

M&MP firms have acquired almost the same number of energy companies as have energy companies acquired M&MP firms. Table 10 shows the breakdown by period. M&MP companies most often bought coal firms or crude petroleum firms. Acquisitions occurred throughout, but peaked from 1968 to 1974.

VALUE OF ASSETS ACQUIRED IN MINING AND MINERAL MERGERS

The trend in the value of assets acquired in M&MP mergers contrasts with the trend in the volume of mergers. Data available to 1979 show the value of purchases of mineral assets began to escalate in the mid-1970's but did not peak until 1978, 9 years after the peak in the volume of mergers occurred. Table 11 shows the total value of assets acquired by year and by case in millions of dollars. It reveals that in dollar terms relatively little merger activity occurred until the 1970's. After total values began to increase in 1972, the total assets acquired in a year quickly reached billion-dollar levels. In 1978, purchases of M&MP companies by nonmining companies totaled almost $7 billion. The value of purchases by M&MP firms increased during the period as well, but by a smaller degree. Although M&MP firms were more active in purchasing non-M&MP companies than vice versa, the value of M&MP assets absorbed by nonmining companies were several times larger than nonmining company assets absorbed by M&MP companies.

From 1960 to 1979 the price index more than doubled, which suggests that in constant money terms the recent surge in activity might be a function of inflated values. This is not entirely so. Figure 5 shows the total value of assets acquired yearly in actual dollars and in constant 1960 dollars. It shows that even in real terms a pronounced increase in asset acquisition. took place beginning in the mid-1970's.

Part of the cause for the increase in asset acquisition

Table 11.—Yearly asset acquisition in mining and mineral firm mergers, million dollars

Year	Case 1, mining firm acquired, 504 mergers	Case 2, mining firm acquiring, 920 mergers	Case 3, mining firm acquired-acquiring, 260 mergers	Total
1960	$2.3	$0.1	$32.0	$34.4
1961	19.7	75.9	1.1	96.7
1962	12.0	1.7	34.1	47.8
1963	31.8	4.0	37.9	73.7
1964	2.6	3.7	11.7	18.0
1965	15.5	4.3	6.3	26.1
1966	.3	1.1	.1	1.5
1967	3.8	6.0	2.5	12.3
1968	10.0	1.5	1.1	12.6
1969	28.8	11.1	1.5	41.4
1970	13.0	79.9	27.6	120.5
1971	7.3	3.2	3.3	13.8
1972	157.3	145.1	19.5	321.9
1973	57.7	220.9	69.3	347.9
1974	541.6	466.0	95.2	1,102.8
1975	55.2	92.9	158.3	306.4
1976	3,589.7	602.5	256.9	4,449.1
1977	4,560.9	1,582.7	30.9	6,174.5
1978	6,893.3	644.7	.0	7,538.0
1979	981.8	1,458.0	37.7	2,477.5
Total	16,984.6	5,405.3	827.0	23,216.9

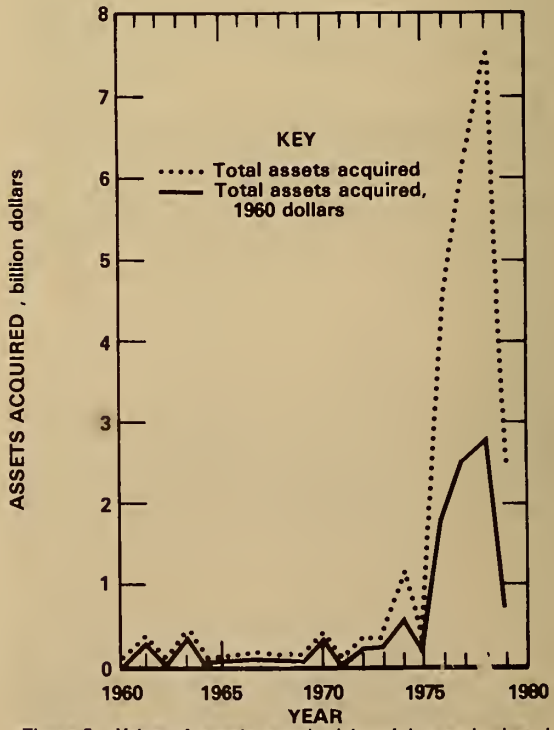

Figure 5.—Value of assets acquired in mining and mineral firm mergers, actual and constant 1960 dollars.

Table 12.—Merger activity of large firms,[1] 1960-79

Year	Acquisitions		M&MP firms as a percentage of manufacturing and mining mergers	Value of assets, million dollars		Assets of large M&MP firms as a percentage of large manufacturing and mining mergers
	Manufacturing and mining	Mining and mineral		Manufacturing and mining	Mining and mineral	
1960	51	1	0.2	$1,535.1	$29.3	1.9
1961	46	3	6.5	2,003.3	72.7	3.6
1962	65	1	1.5	2,251.3	14.0	.6
1963	54	4	7.4	2,535.8	60.5	2.4
1964	73	0	0	2,302.9	.0	.0
1965	64	1	1.6	3,253.7	14.5	.4
1966	76	0	0	3,329.1	.0	.0
1967	138	0	0	8,258.2	.0	.0
1968	174	0	0	12,580.0	.0	.0
1969	138	2	1.4	11,043.2	33.4	.3
1970	91	3	3.3	5,904.3	86.9	1.5
1971	59	0	0	2,459.9	.0	.0
1972	60	8	13.3	1,885.5	265.6	14.1
1973	64	8	12.5	3,148.8	310.2	9.9
1974	62	9	14.5	4,466.4	1,054.5	23.6
1975	59	6	10.2	4,950.5	286.2	5.8
1976	81	22	27.2	6,279.2	4,406.0	70.2
1977	99	20	20.2	8,669.9	6,155.9	71.0
1978	NA	14	NA	NA	7,514.5	NA
1979	NA	18	NA	NA	2,473.6	NA

NA Not Available.
[1] Firms with assets of $10 million or more. Includes all mergers that involved mining and mineral firms regardless of role in merger (whether acquiring or acquired).

Source: U.S. Federal Trade Commission, Bureau of Economics, *Report on Mergers and Acquisitions*, Dec. 1978, and unpublished FTC data.

was the purchase of several very large mineral companies during the late 1970's. Even so, the average merger was getting larger. Large mergers were defined as those mergers in which the assets of the acquired company were worth $10 million or more. From 1960 to 1972 the assets acquired in large mergers comprised anywhere from 0.0 pct to 85.2 pct of all assets acquired in a year. Since 1974 the assets acquired in large mergers comprised at least 93 pct, and from 1976 to 1979, 99 pct of the total assets.

The increase in the number or value of M&MP mergers may have crowded out merger activity in other industries. Table 12 lists the merger activity of large firms from 1960 to 1979. As the number of large mergers increased each year and the total value of assets acquired swelled, M&MP mergers accounted for a larger share of yearly merger activity. In 1977 the value of M&MP assets acquired comprised over 70 pct of all large manufacturing and mining mergers.

MOTIVES FOR MERGER

There are many possible motives that can be used to explain corporate mergers. An understanding of which appear to be most important in mergers may provide an improved basis for ultimately evaluating the impact of mergers on the economy and on the U.S. mining industry in particular.

This section provides a brief review of merger-conglomerate theory and then discusses an analysis of statistical tests for specific motives underlying mergers in the mining and minerals industry.

MERGER-CONGLOMERATE THEORY

Economists, finance theorists, and industrial organization experts have analyzed and debated merger-conglomerate theory for decades. Discussions of the advantages and disadvantages of such complex organizational structures and how such structures were put together led to analyses of the motives behind mergers and conglomerate combinations. For purposes of this brief discussion of merger theory, the exposition will be simplified by separating theories into two schools of thought.

The first school of thought believes that mergers are generally a benefit both to the acquired firm's stockholders—who are usually paid a premium over the market price for their stock—and to the acquiring firm's stockholders because diversification reduces the overall costs of doing business. Oliver Williamson, a noted industrial organization theorist, has analyzed the evolution of the corporation (*5*). He believes that the modern multidivision firm, run by a general management group, is interested in maximizing profits. In the single-division firm, Williamson believes that managers do not maximize profits and instead pursue other goals such as maximizing sales and executive amenities, increasing market shares, and other goals that may not necessarily lead to maximum profits.

Williamson concludes that conglomerate mergers are a way of reducing the transaction costs of conducting business and are thus beneficial to stockholders, in terms of increased profitability, and to society, in terms of increased efficiency in use of resources. The theory of reducing transaction costs subsumes several motives for merger, for example economies of scale in production or consumption of products or services, etc. (*6*).

The other major theory of mergers and conglomeration takes the opposite view. In this theory, single-division firms are more efficient. Managers undertake mergers in order to reduce downward fluctuations in corporate profits and thus assure that their salaries and bonuses, which are tied to profits, are subject to less downside risk. Because most stockholders can attempt to reduce risk by diversifying their own portfolios, the conclusion resulting from this theory is that mergers are not necessarily in stockholders' best interests. Under this theory the economy does not benefit from mergers because the loss of competition results in less efficient use of resources (*7*).

MERGER MOTIVE TESTS

The following three hypotheses were tested as motives for mergers:

1. Mergers occur to reduce the relative earnings volatility.
2. Mergers will improve earnings growth.
3. Assets are purchased because they are less expensive than if bought new today.

In large and complex corporate structures, mergers may be motivated by multiple factors, or by different groups of factors, for each potential merger. However, by testing the motives separately, it can be determined whether viewing any of the three stated motives as an overriding factor is consistent with the data. To this end, univariate procedures were adopted in developing statistical tests for the three hypotheses.[6] In addition, analyses were designed to test mergers collectively rather than individually to determine motives for nonfuel mergers in the mining and mineral industry as a whole.

The procedures used follow the general rules of statistical hypothesis testing. First the hypothesis to be tested is stated. It is called the null hypothesis, because it normally tests a zero difference between two populations. Second, a level of significance is chosen at which one is willing to risk rejecting the hypothesis if it is indeed true. This is called a type 1 error and was variously chosen here as 1, 5, and 7 pct. Third, the test statistic is calculated and compared to a standard value at the chosen significance (error) level. The stated hypothesis is accepted or rejected based on the comparison. If rejected, its alternative is usually stated and accepted but the same error level cannot be applied to the alternative.

The following criteria for selection of the sample were applied: (1) at least one firm, either the acquiring or acquired firm, is a nonfuel mineral company, (2) at least one firm is a U.S. firm, (3) the merger took place during the 1977-82 period, a time when firms were reacting to inflation or perceived inflationary pressures, (4) the merger must have been completed—unsuccessful merger attempts were excluded, (5) the mergers must be considered large (defined as being among the 50 highest valued mergers in a given year) (*1, 8*), and (6) sufficient data were available from publicly available annual reports and/or 10K reports. Eight mergers were selected under the criteria. In all the statistical tests, the identities of the mergers are not given; they are represented by the letters of the alphabet.

It was assumed that an acquiring firm's management would need data for 6 years prior to the merger to judge the most recent performance of the intended acquisition and to make judgments regarding expected future performance. Thus, in conducting the statistical tests, 6 years of data prior to the merger were used.

Relative Earnings Volatility Hypothesis

The relative earnings volatility test examines the earnings stability of the acquiring firm and the acquired firm to determine whether or not if they had been merged for the 6 years prior to their merger their earnings would have been more or less volatile. A simple statistic called the coefficient of variation (COV) was used to conduct the test. The COV is the ratio of the standard deviation of earnings (a measure of the volatility of earnings) divided by the mean value of earnings and multiplied by 100 (to put it in percentage form.) Division by the mean value of earnings normalized earnings variability so that comparisons among earnings volatility of different firms could be made. For the relative earnings volatility hypothesis, the COV of the acquiring firm's earnings was compared with the COV of the "combined firm's" earnings using earnings data for the 6 years prior to the actual merger. To obtain earnings for a combined firm, the two firm's earnings were added. Thus, it was assumed that the merger would have been in effect for 6 years. This procedure tested whether or not reduced relative earnings volatility was a merger motive.

The null hypothesis for this test was that the COV of earnings for the combined firm was no different than the COV of earnings for the acquiring firm. Table 13 lists the COV's for the acquiring firm and the combined firm (assuming that the merger had been in effect during the previous 6 years so that the COV is comparable to the one computed for the acquiring firm). A paired difference test was conducted to see if there was a significant reduction in relative earnings volatility of the acquiring firm as a result of the combination. The paired difference is the average of all the differences (B-A). The standard deviation was computed and a t-test was conducted to see if the eight combinations reduced the relative earnings volatility.

The results indicate that the null hypothesis cannot be rejected; that is, this test *does not* give support to the hypothesis that mergers in the nonfuel mineral industry were undertaken to reduce relative earnings volatility.

Earnings Growth Hypothesis

The earnings growth hypothesis test states that an acquiring firm bought another firm because the purchased firm had a faster earnings growth. The earnings growth rate for both the acquiring and acquired firm was computed by regressing after-tax earnings as an exponen-

[6] Small sample testing techniques are discussed in most basic statistics textbooks, see for example W. Mendenhall and J.E. Reinmuth, *Statistics for Management and Economics*, Duxbury Press, North Scituate, MA, 1979.

Table 13.—Relative earnings volatility hypothesis

(Coefficient of variation of "combined" firm earnings was less than the coefficient of variation of acquiring firm earnings[1])

Merger and date	A, acquiring firm only	B, combined firm	Paired difference,[2,3] B – A = d	Merger and date	A, acquiring firm only	B, combined firm	Paired difference,[2,3] B – A = d
a, 1981	78	76	–2	e, 1981	35	27	–8
b, 1981	29	30	+1	f, 1977	45	84	+39
c, 1982	131	77	–54	g, 1981	108	109	+1
d, 1979	23	22	–1	h, 1976	16	22	+6

[1] Computed using earnings for the 6 years prior to merger. For combined firm, earnings of both firms are combined as if merger had been in effect for 6 years.

[2] Negative values are less volatile and positive values are more volatile.

[3] Paired difference test results—null hypothesis: combination did not reduce relative earnings volatility; n = 8, $\bar{d}$ = average of d for all firms in sample = –2.25. S_d = 25.82, and t_d = d-0/(S_d/√ n) = –2.25/(25.82 √ 8) = 0.2465. Null hypothesis is not rejected since –2.25 is not significantly different from 0 at the 99-pct confidence level. Alternative hypothesis—earnings of the combined firm would have been significantly less volatile than those of acquiring firm—cannot be accepted.

Table 14.—Earnings growth hypothesis

(Acquiring firm bought acquired firm because acquired firm had faster earnings growth)

Merger and date	Firrn annual earnings growth rate, pct		Paired difference,[1] B – A = d	Merger and date	Firm annual earnings growth rate, pct		Paired difference,[1] B – A, = d
	A, acquiring	B, acquired			A, acquiring	B, acquired	
a. 1981	28.2	15.0	–13.2	e. 1981	18.3	2.8	–15.5
b, 1981	14.4	32.5	+18.1	f, 1977	21.8	–51.1	–72.9
c, 1982	32.3	14.7	–17.6	g. 1981	59.1	53.2	–5.9
d, 1979	11.6	–12.1	–23.7	h, 1976	7.5	33.7	+26.2

[1] Paired difference test results—null hypothesis: Earnings growth rates are equal; n = 8; $\bar{d}$ = average of d for all firms in sample = –13.06; S_d = 40.96; t_d = d–0 (S_d √ 8) = –13.06 – 0 (29.96 √ 8) = –0.902. Null hypothesis is not rejected because –0.902 is not significantly different from 0. Alternative hypothesis—acquiring firm purchased acquired firm because acquired firm had faster earnings growth—cannot be accepted.

tial function of time.[7] Once the earnings growth rates for merger partners were determined, a paired difference test was conducted for the eight very large mergers. The results indicated that the hypothesis of acquiring a firm because of higher earnings growth rates could be rejected for the sample group of mergers. Table 14 shows the results of this test.

Replacement Cost Hypothesis

Firms wishing to enter a specific market have to buy capital equipment, buildings, land, and, in the case of energy and mineral firms, land or developed properties that contain energy and mineral reserves and resources. Recent high rates of inflation, however, have caused the costs of entering new markets to rise sharply from one year to the next. Frequently, the inflationary rise has been greater than the increase in a firm's profits. Thus, it has been difficult for a firm to retain enough earnings to expand its business activity. On the other hand, many firms already in a specific business purchased assets before the recent major inflation. On corporate balance sheets, these assets have been valued at depreciated historic purchase costs. Thus, the true asset value of many firms has been understated on balance sheets because of inflation.

The stock market and capital exchanges in the United States tend to value potential growth of near-term profits and not book values. During the recent high inflationary years, many firms in the nonfuel mining and mineral industry had profit growth rates below inflation rates. As a result, the stocks of many firms traded at a price that resulted in the total stock market value of the firm being at a level that was well below the book value of the firm or, even more prevalent and important, below the price that another firm would have to pay to duplicate an existing operation.

In 1980 and 1981, investors, speculators, and managers in energy and mineral firms felt that "assets in the ground" would provide the best hedge against inflation and that these assets could be most inexpensively obtained through merger with existing firms. The wave of mergers in the United States appeared to have been stimulated—at least in part—by the desire of acquiring firms to obtain an inflation hedge at substantially less than the normal, open market replacement cost value.

The hypothesis was set up as follows: if acquiring firms were interested in purchasing other firms (existing assets are less expensive than the outright purchase of new assets), then the market price paid for the acquisition should be less than the replacement cost value of the acquired firm but more than the reported book value. To test this hypothesis, data for the firms were prepared as follows. First the fixed assets of the firm were separated from total assets and the depreciated values of the fixed assets were altered to reflect inflation's impact on asset values at the time of the merger. Next these asset values were multiplied by a price index to obtain the replacement cost of fixed assets for the acquired firm at the time of the merger. When nonfuel mineral firms were the acquisition

[7] The functional form is $E = a(e)^{bt}$, where E = earnings, a = intercept term, b = the compound annual growth rate, e = the base of the natural logarithm, and t = year.

Table 15.—Replacement cost hypothesis

(Price paid for acquisition is less than purchase price of new assets)

	Merger and date	A, price paid per share[1]	B, book value per share	Paired difference,[2] B–A = d_1	C, book value per share at replacement cost	Paired difference,[3] C–A = d_2
a,	1981	$33	$3	–30.00	$18.	–15.00
b,	1981	15	10	–5.00	22.50	+7.50
c,	1982	103	35	–68.00	152	+49.00
d,	1979	44	31	–13.00	82	+38.00
e,	1981	52	22	–30.00	51	–1.00
f,	1977	31	56	+25.00	97	+66.00
g,	1981	62	57	–5.00	140	+78.00
h,	1976	68	22	–46.00	40	–28.00

[1] Cash price or equivalent in stock or bonds.

[2] Null hypothesis 1: Price paid per share was equal to the book value per share; average of d_1 for all firms in sample = –21.5; $S_{d_1} = 28.5$; $S_{\bar{d}_1} = 10.08$; $t_{d_1} = -2.13$. Reject null nypothesis 1 at 95-pct confidence level. Alternative hypothesis: Price paid per share was greater than book value.

[3] Null hypothesis 2: Price paid per share was equal to replacement cost value per share; d_2 = average of d_2 for all firms in sample = –24.31; $S_{d_2} = 38.96$; $S_{\bar{d}_2} = 13$; $t_{d_2} = 1.77$. Reject null hypothesis 2 at 93-pct confidence level. Alternative hypothesis 2: Price paid per share was less than the replacement cost value.

target, it was not possible to get an estimate of the value of reserves. Thus, the replacement cost value of these acquired firms as calculated will probably be understated. For oil and gas energy firms, Securities and Exchange Commission rules require the firms to publish estimates of the value of oil and gas reserves. These estimates were included for the oil and gas firms that were acquired and these figures were used to estimate the replacement cost values of fixed assets for such acquired firms.

Once fixed asset values had been readjusted to estimate their current market replacement cost value, current assets were summed to obtain an estimate of the replacement cost value of all assets. Current liabilities and long-term debts were then subtracted from this total asset value to obtain an estimate of the firm's stockholders' equity (book value), valued at current market replacement costs. It is this estimated value that can help indicate whether or not a firm followed the replacement cost hypothesis motive for acquiring another firm.

Table 15 presents data on the price per share paid by the acquiring firm, the book value per share (or stockholders' equity per share), and the book value per share at current market replacement cost. Two types of paired difference tests were conducted. In the first test, the difference between the book value per share and the price paid per share was computed. Null hypothesis 1 stated that the price paid per share was equal to the book value per share. This hypothesis was rejected at a 95-pct confidence level, implying that significantly more than historical book value was paid.

A companion test, null hypothesis 2, was conducted to see if the price paid was equal to the book value per share computed at current market replacement cost. This hypothesis was rejected at a 93-pct confidence level, implying that significantly less than estimated replacement cost was paid. The weaker conclusion of the second hypothesis is strengthened somewhat by the inability to include the estimated current market value of nonfuel reserves in the replacement cost calculation. Inclusion of the increase in the value of those assets would have increased the estimate of the replacement cost price per share.

SUMMARY

Tests reported in tables 13 and 14 fail to support the hypotheses that either the reduction of earnings volatility or the increase in the rate of earnings growth were major factors in large mining and mineral firm mergers. The tests reported in table 15 support the hypothesis that acquiring firms in mining and mineral firm mergers paid more than historical book value but less than the current market replacement costs of the assets of the acquired firm.

The three tests do not constitute an exhaustive examination of merger motives. Other motives include a desire to expand corporate sales, earnings, product offerings, and services. Unfortunately they could not be tested in a rigorous manner owing to the lack of data. However, the valuation of firms by the stock market instead of the current market replacement cost value of the firm certainly appears to have contributed significantly to recent M&MP mergers.

Given the simple statistical tests of motives for very large mergers used in this study, consideration might be given to expanding the scope of the tests to small- and medium-size mergers. Such tests could provide evidence as to whether or not the results obtained for very large mergers also apply to small- and medium-size mergers. However, the scarcity of detailed data for specific firms may prove to be as much of an obstacle to tests for these sizes of mergers as it was to tests of financial motives not treated in the tests reported here.

The effects of mergers would also be a potentially good subject for hypothesis tests. In addition, there are several areas that might provide fertile ground for examination. For example, one factor that could be studied is the overall state of the economy relative to merger activity. Because of data limitations, this study does not incorporate macroeconomic considerations. However, a booming economy can make a poor merger

look good for a short time while a bad economy can make even the best merger look like a poor decision. A combined firm that performed well during a slack economy might be an indication that the merger has worked well, and vice versa.

A firm's domestic production level could provide some implications as to the impact of a merger in the U.S. nonfuel mineral industry. If an acquiring firm's management demands a higher rate of return on its newly acquired subsidiary's operations, then some of the higher cost operations might be shut down. Of course, it is assumed that such a decision had taken into account the long-run potential of the operation and whether or not a reasonable investment of funds in new plant and equipment could raise profitability to desired levels. If it appeared that a previously independent mining company might have raised the capital for an investment to keep operations running profitably, and if the acquiring firm decided not to undertake an investment because it did not meet its higher profitability criteria, then one could conclude that the merger might have had a negative effect on the U.S. mining industry. Such a test would not be easy to conduct because some of the acquired firms are often in the position of not being able to raise capital to keep operations going, meaning that the investment would not have been made in either case.

Another factor that could reflect the nature of the impact of mergers is whether or not there was a change in sales and distribution systems subsequent to a merger. For instance, if the acquiring firm determined that is could use the minerals (fixed assets) itself, this could upset the operations of other firms that previously depended on the merged firm for minerals supplied. As part of this concern, the degree of concentration at the supplier level and possibly the semifabricating or manufacturing level could be monitored for significant changes.

Another very important factor is the level and distribution of investment. Subsequent to a merger, it is possible that investment in mining operations may increase but that these investments could be in new or existing overseas operations. Such a trend could suggest that the merger has had the effect of keeping domestic operations continuing until overseas opportunities could be pursued. It must be remembered that in many of the base metals, ore grades are higher overseas than in the United States. In addition, labor costs are probably much lower overseas. As a result, any trend toward greater overseas mining investment could well have occurred even if mergers had not taken place. Thus, interpretation of this factor would be subject to some qualifications.

In addition, the level and distribution of exploration efforts could be monitored closely. If a merged firm made a major cut in domestic exploration or shifted exploration overseas, the long-term effect on U.S. minerals production could be negative. On the other hand, a sustained long-run commitment to domestic exploration—even if some domestic operations were shut down because of poor profitability—might indicate a longer term rebound or increase in U.S. mineral production. This is an extremely critical factor because it can take 10 to 30 years to discover a major deposit and another 10 years to develop a mine once the deposit has been sufficiently evaluated.

Finally, another factor for consideration is the performance of the merged firm's stock relative to the market as a whole. An examination of this performance—compared with the stock market performance of the premerger acquiring and acquired firms—could indicate investor perceptions of the effects or impact of the merger. If postmerger relative performance appeared superior to both premerged firms, especially the mining firm, then the merger would be successful from the stockholder's view.

The preceding factors, and others, could be used in tests of the effects of mergers on domestic minerals production. Until these types of factors are explored, the extent of information that can be obtained from company financial data is properly limited to testing for merger motives.

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